APPENDIX 8. SOME PROCEDURES FOR RADAR ANTENNA VERTICAL PATTERN MEASUREMENT BY SOLAR MEANS

4. AUTOMATED MEASUREMENT. Automated systems of measurement have been developed by a few regions to permit not only automated recording of the sun's azimuth passing through the antenna's beam, but then to produce automatically the graph of the beam resulting from the data collection. They use the equipment indicated previously in the manual method with the addition of a high-speed digital voltmeter, a real time clock, and a desktop computer. One region used the HP 3437A voltmeter, the HP 98035A clock and the HP 9825A desktop computer. A block diagram of the setup is found in figure 4.

a. Automated mode operation is different from that of the manual mode described in paragraph 1702. The FSM output is fed to a digital voltmeter, then to a microcomputer which is time calibrated by a real time clock input. When the data collection is completed, the recorded information is taken back to the FMO's office and plotted by using the microcomputer and a suitable plotter. The final product is a vertical pattern plotted by the automated system.

(1) Azimuth reference is required for the system to identify the "window" to record. The purpose here is twofold. First, it greatly reduces extraneous signals from other radars from getting into the data base. Secondly, it reduces the need for memory and permits putting the whole recording on one tape. As the block diagram shows, the radar's Azimuth Reference Pulse (ARP) is used in conjunction with the clock to open the data window only for a few degrees before and then closing it a few degrees after the antenna scans the sun area.

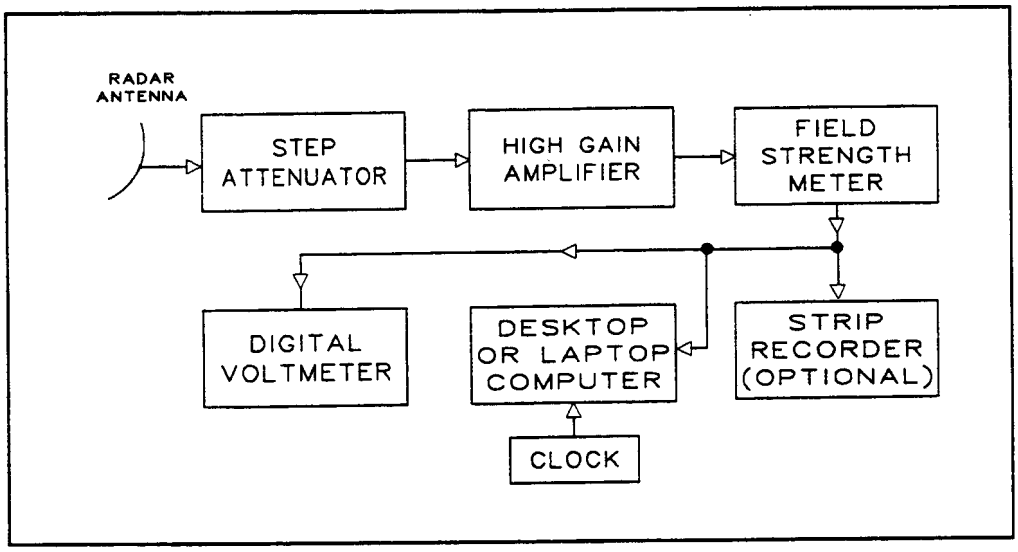
(2) The digital voltmeter is used to assure the overall signal applied to the computer does not exceed 1.5 V, the system maximum permissible value. It also serves to integrate the ARP into the system.

(3) The microcomputer is used primarily to program the measurement system, and once done, needs only "fill-ins" to run other radar measurements. It also serves to provide magnetic tape recording of the data as it is produced. After the recording is completed, it is used to playback the data and provide program information to the plotter for the final plotting.

(4) The plotter is used purely for graphics in plotting the final graph itself. Any good plotter compatible with the program language may be used.

(5) Strip recording can be done simultaneously to allow eye viewing of real time progress of the recording session. It is valuable to do so as a monitoring tool to assure that all peripherals are operating in their proper mode. It allows the FMO to see the increasing, peaking and decreasing levels as the sun traverses the vertical beam path. For this reason, it is shown as optional in the block diagram of figure 4.

FIGURE 4. AUTOMATED RADAR ANTENNA SOLAR MEASUREMENT BLOCK DIAGRAM



b. A Regional automated program upon which this paragraph description and system have been based, has been written by the region who developed it and is available. A 16-page, three-file program is available from ASR. Other programs have been developed subsequently by other regions and also are available through ASR. At present, the decision as to whether the FMO should use an automated system or manual is dependent upon the FMO's choice and availability of equipment. The computer programs are not included in this manual. With the rapid growth in microcomputers, laptop computers and engineers' knowledge of programming, any FMO who wishes to write a program is encouraged to do so. It is requested that if a successful program for automated solar measurements is written, the FMO will forward it to ASR for study and circulation to other regions.

c. A HQ automated system has been devised by the Surveillance Systems Engineering Branch (AOS-230). It is designed to use with ASR, ARSR and ATCRBS antennas. It utilizes low-noise amplifiers, HP 8500 series spectrum analyzers and a microcomputer with HP-Basic language. The information entitled *Radar Antenna Solar Data Recording And Analysis* can be procured from ASR.

5. DOCUMENTATION. As with other engineering data described in other chapters of this manual, any and all measurements and plots will be placed in the facility file as part of the permanent engineering record of the facility. Since spectrum management records are exempt from the destruction schedule, these records will serve as a permanent record of antenna capability and performance. They also can provide important clues to any suspected improper operation of the facility.